

WHAT IS CLAIMED IS:

1 1. A system for forming and quenching glass sheets, comprising:
2 a furnace having entry and exit ends and including a heating chamber
3 having a conveyor for conveying glass sheets along a direction of conveyance
4 through the furnace from the entry end to the exit end;
5 the exit end of the furnace including a roll bending station within the
6 heating chamber, the roll bending station including a roll conveyor having
7 horizontally extending conveyor rolls that are rotatively driven and spaced
8 horizontally within the heating chamber along the direction of conveyance extending
9 laterally with respect thereto to support and convey the heated glass sheets, the roll
10 bending station having a pair of sets of bending rolls that are spaced laterally with
11 respect to each other within the heating chamber along the direction of conveyance,
12 and a drive mechanism that supports each set of the bending rolls with the rolls
13 thereof at progressively increasing inclinations along the direction of conveyance
14 and that provides rotational driving of the bending rolls to provide bending of the
15 conveyed glass sheets along a direction transverse to the direction of conveyance;
16 a press bending station located externally of the furnace downstream
17 along the direction of conveyance from the exit end of the furnace to receive the
18 bent glass sheets from the exit end of the furnace, the press bending station having
19 a lower ring mold and an upper press mold that have curved shapes along and
20 transverse to the direction of conveyance, and an actuator that provides relative
21 vertical movement between the lower ring mold and the upper press mold to bend
22 a glass sheet therebetween and cooperate with the roll bending station in forming
23 the glass sheet with curvatures both along and transverse to the direction of
24 conveyance; and
25 a quench station for rapidly cooling the formed glass sheet to provide
26 toughening.

1 2. A system for forming and quenching glass sheets as in claim
2 1 the drive mechanism is located externally of the furnace with the bending rolls
3 projecting inwardly into the furnace.

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1 3. A system for forming and quenching glass sheets as in claim
2 1 wherein the press bending station actuator moves the lower ring mold vertically
3 to provide the glass sheet forming.

1 4. A system for forming and quenching glass sheets as in claim
2 1 wherein the press bending station actuator moves the upper press mold vertically
3 to provide the glass sheet forming.

1 5. A system for forming and quenching glass sheets as in claim
2 1 wherein the press bending station actuator moves both the lower ring mold and
3 the upper press mold vertically to provide the glass sheet forming.

1 6. A system for forming and quenching glass sheets, comprising:
2 a furnace having entry and exit ends and including a heating chamber
3 having a conveyor for conveying glass sheets along a direction of conveyance
4 through the furnace from the entry end to the exit end;
5 the exit end of the furnace including a roll bending station within the
6 heating chamber, the roll bending station including a roll conveyor having
7 horizontally extending conveyor rolls that are rotatively driven and spaced
8 horizontally within the heating chamber along the direction of conveyance extending
9 laterally with respect thereto to support and convey the heated glass sheets, the roll
10 bending station having a pair of sets of bending rolls that are spaced laterally with
11 respect to each other within the heating chamber along the direction of conveyance,
12 and a drive mechanism that is located externally of the furnace and that supports the
13 bending rolls at progressively increasing inclinations along the direction of
14 conveyance as well as providing rotational driving of the bending rolls to provide
15 bending of the conveyed glass sheets along a direction transverse to the direction
16 of conveyance;
17 a press bending station located externally of the furnace downstream
18 along the direction of conveyance from the exit end of the furnace to receive the
19 bent glass sheets from the exit end of the furnace, the press bending station having
20 a lower ring mold and an upper press mold that have curved shapes along and
21 transverse to the direction of conveyance, and an actuator that moves both the lower

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22 ring mold and the upper press mold vertically to bend a glass sheet therebetween
23 and cooperate with the roll bending station in forming the glass sheet curvatures
24 both along and transverse to the direction of conveyance; and
25 a quench station for rapidly cooling the formed glass sheet to provide
26 toughening.

1 7. A method for forming and quenching glass sheets comprising:
2 conveying a glass sheet within a heating chamber of a furnace
3 from an entry end thereof toward an exit end thereof to provide heating thereof for
4 forming;

5 continuing to convey the heated glass sheet on rotary horizontally
6 extending rolls within the furnace heating chamber adjacent the exit end of the
7 furnace and engaging opposite lateral sides of the roll conveyed glass sheet with a
8 pair of sets of rotatively driven bending rolls that are spaced laterally from each
9 other within the furnace heating chamber with each set having a plurality of bending
10 rolls spaced along the direction of conveyance with progressively increasing
11 inclinations to provide bending of the conveyed glass sheets along a direction
12 transverse to the direction of conveyance;

13 conveying the bent glass sheet out of the heating chamber of the
14 furnace through the exit end thereof to between a lower ring mold and an upper
15 press mold that have curved shapes along and transverse to the direction of
16 conveyance;

17 providing relative vertical movement between the lower ring mold
18 and the upper press mold to bend a glass sheet therebetween and cooperate with the
19 initial roll bending to form the glass sheet curvatures both along and transverse to
20 the direction of conveyance; and

21 thereafter rapidly cooling the formed glass sheet to provide
22 toughening.

1 8. A method for forming and quenching glass sheets as in claim
2 7 wherein each set of bending rolls is rotatively supported and driven from
3 externally of the furnace with the bending rolls thereof projecting into the heating
4 chamber.

1 9. A method for forming and quenching glass sheets as in claim
2 7 wherein the lower ring mold is moved vertically to press bend the glass sheet.

1 10. A method for forming and quenching glass sheets as in claim
2 7 wherein the upper press mold is moved vertically to press bend the glass sheet.

1 11. A method for forming and quenching glass sheets as in claim
2 7 wherein both the lower ring mold and the upper press mold are moved vertically
3 to press bend the glass sheet.

1 12. A method for forming and quenching glass sheets comprising:
2 conveying a glass sheet within a heating chamber of a furnace
3 from an entry end thereof toward an exit end thereof to provide heating thereof for
4 forming;
5 continuing to convey the heated glass sheet on rotary horizontally
6 extending rolls within the furnace heating chamber adjacent the exit end of the
7 furnace and engaging opposite lateral sides of the roll conveyed glass sheet with a
8 pair of sets of bending rolls that are rotatively supported and driven from externally
9 of the furnace and spaced laterally from each other with each set having a plurality
10 of bending rolls projecting into the heating chamber and spaced along the direction
11 of conveyance with progressively increasing inclinations to provide bending of the
12 conveyed glass sheets along a direction transverse to the direction of conveyance;
13 conveying the bent glass sheet out of the heating chamber of the
14 furnace through the exit end thereof to between a lower ring mold and an upper
15 press mold that have curved shapes along and transverse to the direction of
16 conveyance;
17 moving both the lower ring mold and the upper press mold vertically
18 to bend a glass sheet therebetween and cooperate with the initial roll bending to
19 form the glass sheet curvatures both along and transverse to the direction of
20 conveyance; and
21 thereafter rapidly cooling the formed glass sheet to provide
22 toughening.

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